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Written by : Franck CADOUX

Approved by : Jean-Pierre VIALLE

Presents:

Physicists: JP Vialle, Yu cheng Lu, R. Kossakowski, G. Coignet,
Mechanical team: JM Dubois, F. Peltier, B. Lieunard, F. Cadoux

Abstract:

*This note reviews the inspection of the **ECAL engineering model** performed at LAPP the 15th of May 2002 on delivery of it, with the presence of representatives of IHEP (Beijing). This detector was shipped from Beijing to CERN at the end of April 2002, and then moved to LAPP.*

1. Introduction

After the test beam of october 2001, the ECAL engineering model was shipped to Beijing for making modifications to the mechanical support structure and replacing some parts. The modifications comprise the replacement of the lateral panels spring foams (use of 2.5 mm thick Therm-a-gap) and of the honeycomb panels top and bottom. Some shear pins were also added to the structure. The Pancake was removed from the mechanical support structure at IEHP and then mounted again in the mechanical support structure after that the modifications took place.

The aim of the inspection was to check the exact state of the device, the dimensions and their compliance with the drawings, (including the PMT tubes insertion), the total weight.

2. Delivery at LAPP- Opening of the box and Visual inspection

The ECAL in its
Packaging for
transportation



The box was opened carefully and a visual inspection was made before any handling. Several set of scratches are observed on the cover plate of honeycomb, though being superficial. On the sides, the

lateral panels are the same as for the former test beam. The corners of the holes still keep track of the filing made previously to correct the wrong diagonal size of the holes.

From the inspection of the holes for PMT's on the lateral panels, it appears that the spring foam is not properly positioned on the inner bars the lateral panel, so that many holes are partly obstructed (by about 1 mm) by the spring foam. It is therefore clear that the go-nogo gauge test shown in a transparency at the TIM meeting in may has been performed before mounting the spring foam and assembling the structure with the pancake. It will be necessary in the future to make the test in the right way, when the support structure is closed with the pancake in it.

Due to this default, it will be necessary to push the spring foam off the holes with a special tool before mounting the PMT tubes.



From the careful inspection of the ECAL it seems that there is some damage on an edge the pancake.

The picture on the right shows that some fibres on the edge are either missing or damaged. This was not observed previously. Though it is not possible today to identify the origin of the problem, it is clear that special care should be taken while inserting the pancake in the mechanical support structure to avoid such problem.



3.1. Scheme of measurement

1000 mm (USS II interface)

Lateral panel outer dimension

Pancake dimension

TOP VIEW of Ecal

SIDE C

SIDE D

SIDE B

SIDE A

Bracket (old version shown)

Pancake

Lateral panel

Reference of corner

Lateral spring foam (Therm-a-gap material)

Pancake

Lateral panel

- First, the depth of each square hole (40 mm expected according to the plans) was controlled.
- The lateral panel's outer dimension for each corner (822 mm expected) has been measured,
- The flatness of both honeycomb panels has been checked,
- The dimensions of the pancake have been measured by using some depth gauges (to get the resulting thickness of the foam, and then its compression rate),
- Last, the position of the lateral foam with respect to the lateral panel holes has been checked.

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3.2. Results

Measured dimensions:

Item	Side A/C ₁	Side A/C ₂	Side B/D ₁	Side B/D ₂	Reference
Pancake dimensions	657.6	657.6	657.3	657.3	658
Square holes depth	40.5 / 40.0	40.5 / 40.5	40.5 / 40.0	40.1 / 40.7	40
Lateral panel outer dim.	822.1*	822.5	822.1	822.6	822
Spring foam (compressed)	2.5 / 2.0	2.5 / 2.5	2.5 / 2.0	2.1 / 2.7**	2

* Note that the mean distance measured in Pisa on the first ECAL assembly (in 2001) was 823 mm!

** Means different compression rates on the foam. **But the measurement of the foam thickness before assembly (from China) with Pancake is necessary.**

From the measurement of the thickness of the honeycomb compressed, there is some concern about how well the pancake is maintained inside the structure. If the pressure on the pancake from the spring foam is not sufficient, the pancake could move in an uncontrolled way inside the mechanical structure during the space qualification tests.

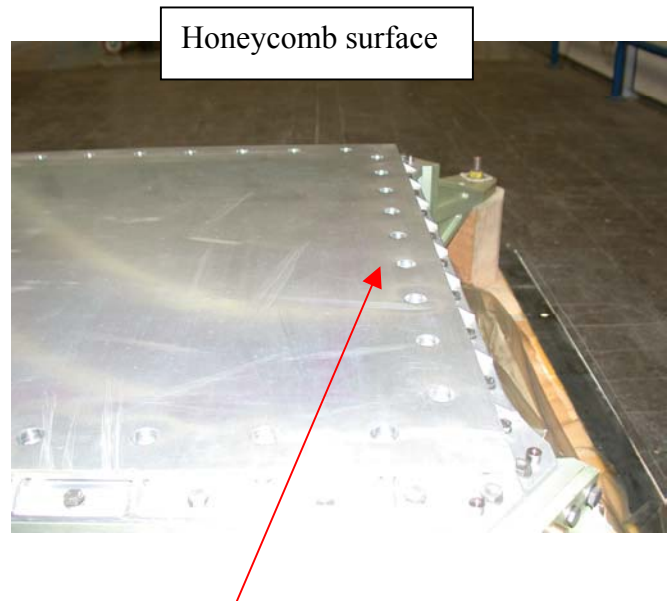
Honeycomb flatness:

no important central deflection occurred (less than 0.2 mm). The only small deflection is near the connexion (gluing) with its aluminium frame.

Spring foam position: as mentioned in the section on visual inspection, the spring foam is not correctly positioned on the lateral panel in some of the PMT holes. The **centring defect** was measured to be between 0.5 mm and 1 mm in some holes) which need to be fixed before mounting the light collection system.



Spring foam overrun



Small deflection at the frame interface with the aluminium foil

4. Check of ECAL Weight

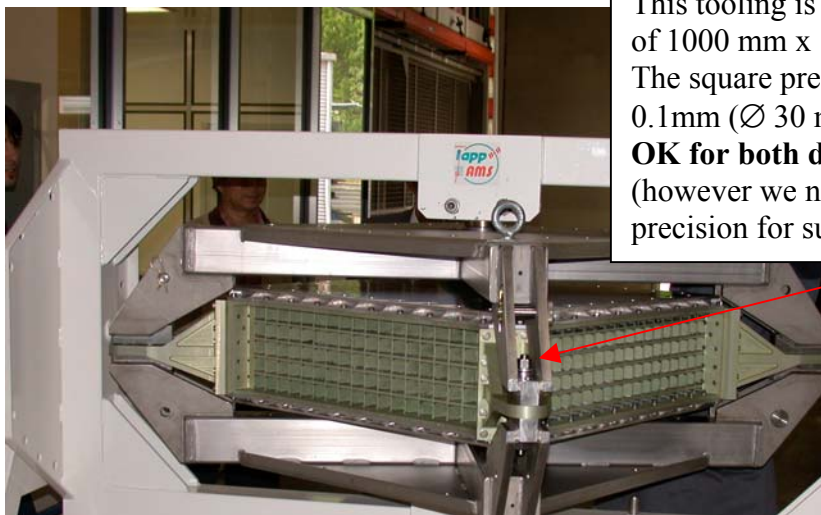


Display in ton

The Ecal weight including supporting structure (Lateral panels, brackets, honeycombs, bolts, screws, shearing pins, spring foams) and pancake has been measured by using a weighing machine displaying the result in tons. According to the oscillation between 560 Kg and 570 Kg a weight close to **565 Kg** can be assumed (to be confirmed by a weighing of each piece)

For the whole ECAL, the estimate must include in addition the weight of the light collection system which is assembled after the primary assembly.

5. ECAL in the tooling used for the PMT tube insertions



This tooling is also a way to check the square of 1000 mm x 1000 mm (USSII interface). The square precision of the tooling is $\pm 0.1\text{mm}$ ($\varnothing 30\text{ mm}$ for the holes).

OK for both dimensions and flatness.
(however we need to know exactly the USSII precision for such a length).

6. Conclusions

Many of the measurements done during the inspection of the ECAL structure are within tolerances from the nominal value. However, some defects have been observed which need to be understood and corrected before the flight model is built, namely :

- The depth of the holes for the PMT is not constant (vary by more than .6 mm). This should be improved.
- In some of the PMT holes, the spring foam of the lateral panel overruns in the hole, thus making impossible to mount the PMT. A manual intervention to fix it is then necessary, with a risk to damage the pancake. The go-nogo gauge for the holes should be used for checking before and after the assembly of the lateral panel on the Pancake.
- From the measurement, there is some concern on how well the pancake is fixed in the structure. The spring foam compression is a key number for estimating the Pancake behaviour in term of acceleration-vibration. So **the knowledge of the thickness of each spring foam (help of China) used** is necessary for the FEA calculation (our first measurement on samples was close to 2.7 mm, but with a dispersion of ± 0.1 mm).

An similar inspection will be done after the test beam and before shipping to Beijing to check that there is no damage done to the structure during this time.